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Airborne Sound Transmission Loss Measurements of Magnetite Window Systems

Magnetite Canada

A1-009464.1

19 September 2016

National Research Council Canada | Conseil national de recherches Canada

Canada

Airborne Sound Transmission Loss Measurements of Magnetite Window Systems

Author

Frances King, M. Eng., P. Eng.
Technical Officer
Acoustics
NRC Construction

Approved

Philip Rizcallah, P. Eng.
Program Lead
Building Regulations for Market Access
NRC Construction

Report No: A1-009464.1
Report Date: 19 September 2016
Contract No: A1-009464
Agreement date: 1 June 2016
Program: Building Regulations for Market Access

19 pages

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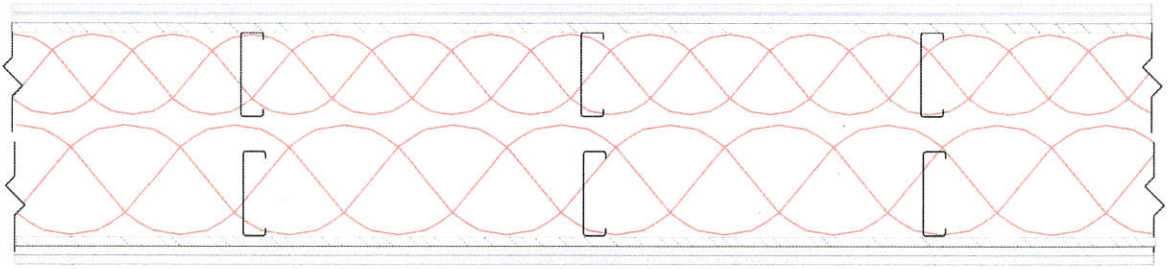
Summary

This report contains the Sound Transmission Loss (TL) test results of the Magnetite framing system mounted on two different types of window, a single pane wood window and a double pane aluminum window. The TL was measured in accordance with ASTM E90-09 ("Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.") The opening of the NRC Wall Sound Transmission Facility test frame was reduced to accommodate the window systems using a filler wall in accordance with the procedures in the ASTM E90 standard. The filler wall had high sound insulation and transmitted negligible sound compared to the sound transmitted through the window systems. The filler wall was built with support structures for the window systems in place and the window system already mounted in the filler wall. By measuring the TL of the complete filler wall with the window system covered and the composite filler wall with the window system uncovered, the TL of the window system was calculated in accordance with the procedures in the ASTM E90 standard.

This report presents the description, the measured and the calculated one-third octave band transmission loss and the single-number rating, Sound Transmission Class (STC), in accordance with ASTM E413 of the filler wall, the single pane wood window, the single pane wood window with the Magnetite framing system, the double pane aluminum window, and the double pane aluminum window with the Magnetite framing system. The measurement procedures are described in Appendix A.

The test results show that the Magnetite Framing System improved the STC values of both the single pane wood window and the double pane aluminum window by 16 point when it was installed with an air space of 100 mm (4") between the glass pane and the Magnetite Framing System.

1. Filler Wall



2G16_OTH16_GFB92_SS92(610)_AIR25_SS92(610)_GFB152_OTH16_2G16

Description

One layer of 15.9 mm (5/8") acoustic panels and two layers of 15.9 mm (5/8") type X gypsum board directly attached to both sides of a double row of 92 mm (3-5/8") 25 gauge steel studs spaced 610 mm o.c. with an air gap of 25 mm (1") between the studs.

Side 1

- One layer of 15.9 mm (5/8") acoustic panels directly attached to steel studs using 32 mm (1-1/4") screws spaced 610 mm o.c.
- One layer of 15.9 mm (5/8") type X gypsum board attached as middle layer using 41 mm (1-5/8") screws spaced 305 mm o.c. along the edges and 610 mm o.c. in the field.
- One layer of 15.9 mm (5/8") type X gypsum board attached as face layer using 51 mm (2") screws spaced 305 mm o.c. along the edges and 610 mm o.c. in the field.
- Joints of middle layer gypsum board staggered by at least one stud spacing from joints of acoustic panels.
- Joints of face layer gypsum board staggered by at least one stud spacing from joints of middle layer gypsum board.
- Gaps along the joints and the perimeter of gypsum boards caulked and taped with aluminum tape.

Framing & Cavity Insulation

- A layer of sill gasket was placed between wall framing and test frame.
- Two rows of 92 mm (3-5/8") 25 gauge steel studs (steel thickness: 0.46 mm/0.018") spaced 610 mm o.c. with an air gap of 25 mm (1") between the studs.
- Base track attached to test frame using screws 13 mm (1/2") long spaced 610 mm o.c.
- Top track attached to test frame using screws 13 mm (1/2") long spaced 610 mm o.c.
- End studs attached to test frame using screws 13 mm (1/2") long spaced 610 mm o.c.
- Steel studs attached to base track and top track using screws 13 mm (1/2") long at each side.
- 152 mm (6") thick Owens Corning QuietZone glass fiber batts between first row

of steel studs.

- 92 mm (3-5/8") thick Owens Corning R12 glass fiber batts between second row of steel studs.
- Support structure built to accommodate 1418 mm x 1138 mm single pane wood window.
- Window mounted in the opening with the opening closed and finished with glass fiber and 2 layers of gypsum board on each side.

Side 2

- One layer of 15.9 mm (5/8") acoustic panels directly attached to steel studs using 32 mm (1-1/4") screws spaced 610 mm o.c.
- One layer of 15.9 mm (5/8") type X gypsum board attached as middle layer using 41 mm (1-5/8") screws spaced 305 mm o.c. along the edges and 610 mm o.c. in the field.
- One layer of 15.9 mm (5/8") type X gypsum board attached as face layer using 51 mm (2") screws spaced 305 mm o.c. along the edges and 610 mm o.c. in the field.
- Joints of acoustic panels staggered by at least one stud spacing from joints of Side 1 acoustic panels.
- Joints of middle layer gypsum board staggered by at least one stud spacing from joints of acoustic panels.
- Joints of face layer gypsum board staggered by at least one stud spacing from joints of middle layer gypsum board.
- Gaps along the joints and the perimeter of gypsum boards caulked and taped with aluminum tape.

Table 1. Specimen Properties of Filler Wall

Element	Actual thickness (mm)	Mass (kg)	Mass/length, area or volume
Type X Gypsum Board	15.9	103.5	11.6 kg/m²
Type X Gypsum Board	15.9	103.5	11.6 kg/m²
Acoustic panel	15.9	32.1	3.6 kg/m²
Steel Studs and Tracks	92	8.9	0.37 kg/m
Glass Fiber Insulation	92*	8.1	9.9 kg/m³
Air	25	0	0
Glass Fiber Insulation	152*	11.3	8.33 kg/m³
Steel Studs and Tracks	92	8.9	0.37 kg/m
Acoustic panel	15.9	32.1	3.6 kg/m²
Type X Gypsum Board	15.9	103.5	11.6 kg/m²
Type X Gypsum Board	15.9	103.5	11.6 kg/m²
Total	**304.4**	**515.4****	

* Element thickness does not contribute to total thickness (i.e. in cavity)
** Mass of the original complete filler wall before mounting the window systems.

Figure 1. Filler wall with support structure built to accommodate 1418 mm x 1138 mm single pane wood window with the opening closed and finished with glass fiber and 2 layers of gypsum board on each side.

ASTM E90 Test Results – Airborne Sound Transmission Loss

Client: Magnetite Canada **Test ID:** TLA-16-062

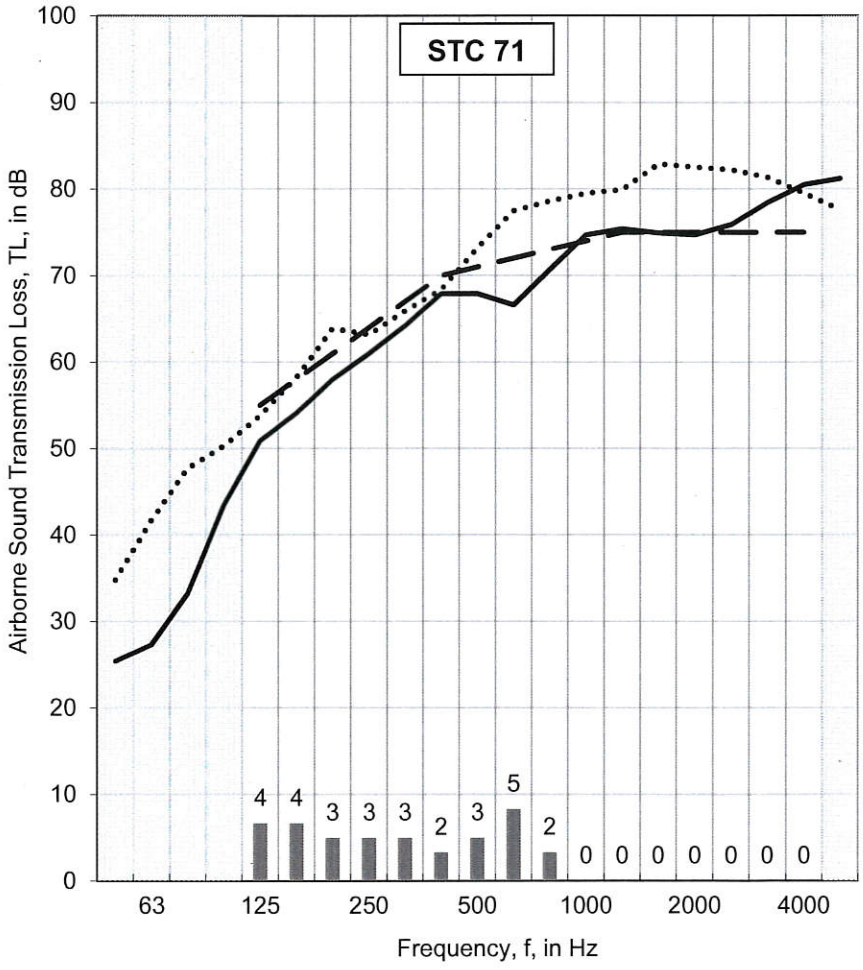
Specimen ID: A1-009464-2F **Date of Test:** August 18, 2016

Room	Volume (m^3)	Air Temperature (°C)	Humidity (%)
Large	254.9	21.7 to 21.7	70.4 to 71.2
Small	140.6	21.4 to 21.4	71.3 to 72.7

Area of test specimen:	8.92 m^2
Mass of test specimen:	515.4 kg

f (Hz)	TL (dB)	
50	25	
63	27	
80	33	
100	44	
125	51	
160	54	
200	58	
250	61	
315	64	
400	68	
500	68	
630	67	
800	71	
1000	75	
1250	75	c
1600	75	
2000	75	
2500	76	
3150	78	
4000	81	c
5000	81	*
Sound Transmission Class (STC)	**71**	

Sum of Deficiencies (dB)
29
Max. Deficiency (dB)
5 dB at 630 Hz



For a description of the test specimen and mounting conditions see text pages before. The results in this report apply only to the specific sample submitted for measurement. No responsibility is assumed for performance of any other specimen. **Airborne sound transmission loss measurements were conducted in accordance with the requirements of ASTM E90-09, "Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements."**

In the graph:
The solid line is the measured sound transmission loss for this specimen. The dashed line is the STC contour fitted to the measured values according to ASTM E413-10. The dotted line (may be above the displayed range) is 10 dB below the flanking limit established for this facility. For any frequency band where the measured transmission loss is above the dotted line, the reported value is potentially limited by flanking transmission via laboratory surfaces, and the true value may be higher than that measured. Bars at the bottom of the graph show deficiencies where the measured data are less than the reference contour as described in the fitting procedure for the STC, defined in ASTM E413-10. The shaded cells in the table and areas in the graph are outside the STC contour range.

In the table:
Values marked "c" indicate that the measured background level was between 5 dB and 10 dB below the combined receiving room level and background level. The reported values have been corrected according to the procedure outlined in ASTM E90-09. Values marked "*" indicate that the measured background level was less than 5 dB below the combined receiving room level and background level, in which case, the corrected values provide an estimate of the lower limit of airborne sound transmission loss.

2. Single Pane Wood Window Mounted in Filler Wall

Description

1418 mm high x 1138 mm wide single pane wood window was mounted in the 2440 mm high x 3658 mm wide filler wall. See Section 1 for the description of the filler wall.

Framing

- Support structure for the window was built with double rows of 92 mm (3-5/8") 25 gauge steel studs (steel thickness: 0.46 mm/0.018") with an air gap of 25 mm (1") between the studs.
- Support structure was lined with two layers of 15.9 mm (5/8") type X gypsum board on the side and several layers of 15.9 mm (5/8") type X gypsum board on the top to fit the window. A small gap of less than 5 mm was left opened between the two rows of framing. The gap was filled with backer rods, caulking and aluminum tape.
- A layer of sill gasket was placed at the bottom of the support structure.
- Gaps along the perimeter of the window were filled with backer rods, caulking and aluminum tape.

Table 2. Specimen Properties of Single Pane Wood Window

Element	Actual thickness (mm)	Mass (kg)
4 mm Single Pane Glass Wood Window	140*	32.6

* Element thickness includes the wood sash of the window.

Figure 2. 1418 mm high x 1138 mm wide single pane wood window was mounted in the 2440 mm high x 3658 mm wide filler wall.

ASTM E90 Test Results – Airborne Sound Transmission Loss

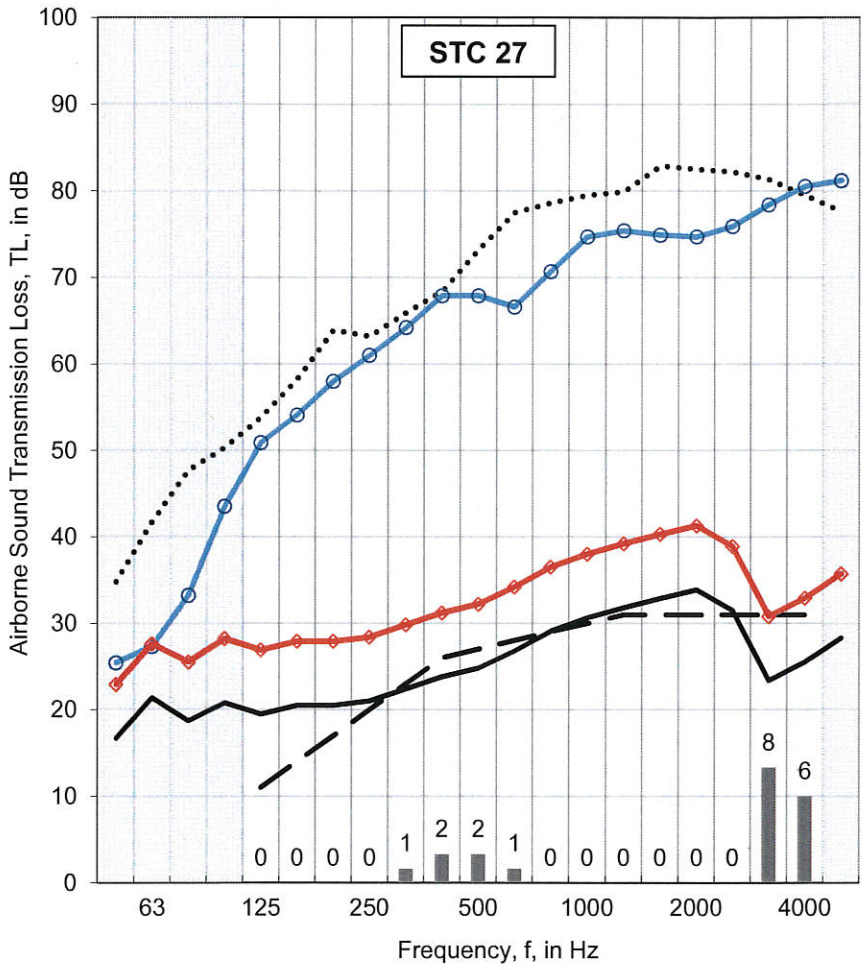
Client: Magnetite Canada **Test ID:** TLA-16-063

Specimen ID: A1-009464-1W **Date of Test:** August 18, 2016

Room	Volume (m³)	Air Temperature (°C)	Humidity (%)
Large	254.9	21.7 to 21.7	68.9 to 69.5
Small	140.6	21.4 to 21.4	69.6 to 70.3

Area of test specimen:	1.61 m^2
Mass of test specimen:	32.6 kg

f (Hz)	TL (dB)
50	17 min
63	21 min
80	19 clc
100	21
125	20
160	21
200	21
250	21
315	22
400	24
500	25
630	27
800	29
1000	31
1250	32
1600	33
2000	34
2500	32
3150	23
4000	26
5000	28
Sound Transmission Class (STC)	**27**



Sum of Deficiencies (dB)
20
Max. Deficiency (dB)
8 dB at 3150 Hz

For a description of the test specimen and mounting conditions see text pages before. The results in this report apply only to the specific sample submitted for measurement. No responsibility is assumed for performance of any other specimen. **Airborne sound transmission loss measurements were conducted in accordance with the requirements of ASTM E90-09, "Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements."**

In the graph:

The blue solid line with circle markers is the measured sound transmission loss of the filler wall. The red solid line with diamond markers is the measured sound transmission loss of the filler wall with the single pane wood window. The black solid line is the calculated sound transmission loss for the single pane wood window. The dashed line is the STC contour fitted to the calculated values according to ASTM E413-10. The dotted line (may be above the displayed range) is 10 dB below the flanking limit established for this facility. For any frequency band where the measured transmission loss is above the dotted line, the reported value is potentially limited by flanking transmission via laboratory surfaces, and the true value may be higher than that measured. Bars at the bottom of the graph show deficiencies where the measured data are less than the reference contour as described in the fitting procedure for the STC, defined in ASTM E413-10. The shaded cells in the table and areas in the graph are outside the STC contour range.

In the table:

Values marked "clc" indicate that the measured sound transmission loss of the specimen was calculated according to ASTM E90-09, section A.3.2.7. A correction through the filler wall was applied for calculating the sound transmission loss of the single pane wood window. Values marked "min" indicate that the measured sound transmission loss of the specimen was calculated according to ASTM E90-09, section A.3.2.8 and the values give an estimate of the lower limit of airborne sound transmission loss.

3. Single Pane Wood Window with Magnetite Framing System

Description

1498 mm high x 1196 mm wide Magnetite Framing System was installed next to the 1418 mm high x 1138 mm wide single pane wood window with an airspace of 100 mm (4") between the glass pane and the Magnetite acrylic pane. See Section 1 for the description of the filler wall and Section 2 for the description of the single pane wood window.

Framing

- 25 gauge power coated steel L bars lined with 5 mm foam tape were attached to the perimeter of the test opening on the large chamber side 100 mm (4") away from the single pane wood window.
- 100 mm (4") wide x 19 mm (¾") thick white foam strip lined the perimeter between glass pane and Magnetite acrylic pane.
- Magnetite Framing System attached to the steel L bars with backer rods around the outside perimeter of the Framing System.

Table 3. Specimen Properties of Magnetite Framing System

Element	Actual thickness (mm)	Mass (kg)
6 mm acrylic pane with magnetic strip on one side of the metal frame	15 mm*	13.6

* Element thickness includes the metal frame of the Magnetite Framing System.

Figure 3. 1496 mm high x 1196 mm wide Magnetite Framing System was installed 100 mm away from the 1418 mm high x 1138 mm wide single pane wood window.

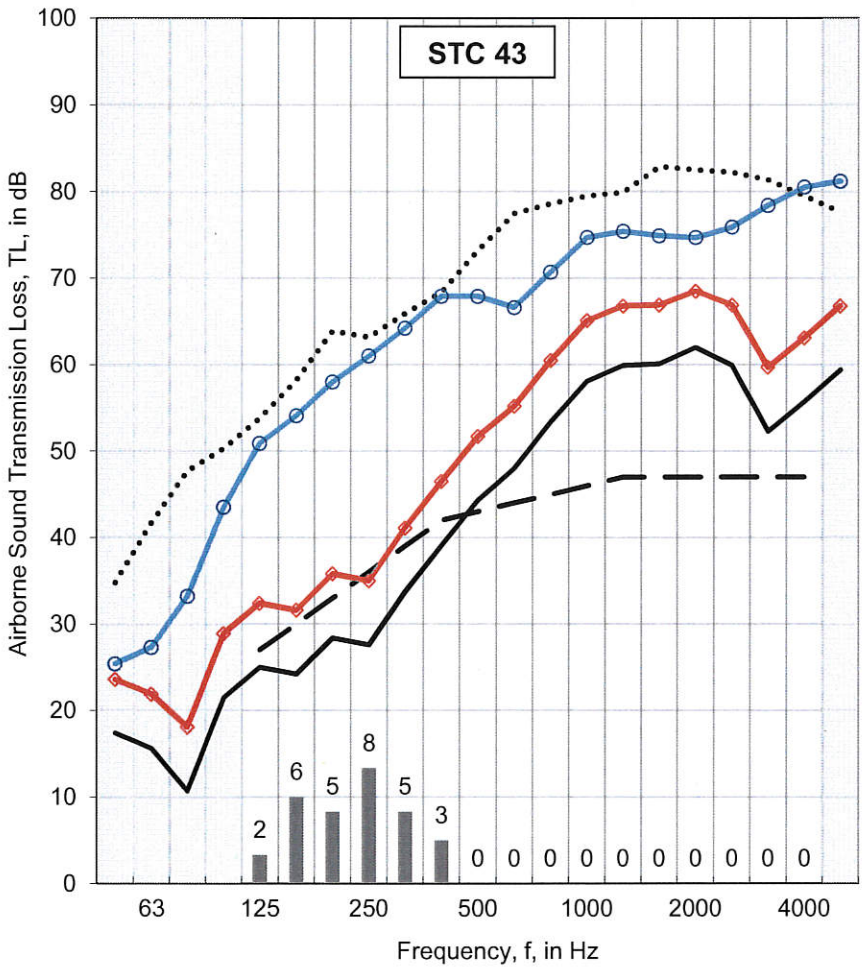
ASTM E90 Test Results – Airborne Sound Transmission Loss

Client: Magnetite Canada
Specimen ID: A1-009464-1WM
Test ID: TLA-16-064
Date of Test: August 19, 2016

Room	Volume (m^3)	Air Temperature (°C)	Humidity (%)
Large	254.9	21.8 to 22	67.7 to 67.8
Small	140.6	21.5 to 21.5	65.4 to 65.6

Area of test specimen:	1.61 m^2
Mass of test specimen:	13.6 kg

f (Hz)	TL (dB)	
50	17	min
63	16	clc
80	11	
100	22	
125	25	
160	24	
200	28	
250	28	
315	34	
400	39	
500	44	
630	48	clc
800	53	clc
1000	58	clc
1250	60	clc
1600	60	clc
2000	62	clc
2500	60	clc
3150	52	
4000	56	
5000	59	
Sound Transmission Class (STC)	**43**	



Sum of Deficiencies (dB)
29
Max. Deficiency (dB)
8 dB at 250 Hz

For a description of the test specimen and mounting conditions see text pages before. The results in this report apply only to the specific sample submitted for measurement. No responsibility is assumed for performance of any other specimen. **Airborne sound transmission loss measurements were conducted in accordance with the requirements of ASTM E90-09, "Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements."**

In the graph:
The blue solid line with circle markers is the measured sound transmission loss of the filler wall. The red solid line with diamond markers is the measured sound transmission loss of the filler wall with the single pane wood window and the Magnetite Framing System. The black solid line is the calculated sound transmission loss of the single pane wood window with the Magnetite Framing System. The dashed line is the STC contour fitted to the calculated values according to ASTM E413-10. The dotted line (may be above the displayed range) is 10 dB below the flanking limit established for this facility. For any frequency band where the measured transmission loss is above the dotted line, the reported value is potentially limited by flanking transmission via laboratory surfaces, and the true value may be higher than that measured. Bars at the bottom of the graph show deficiencies where the measured data are less than the reference contour as described in the fitting procedure for the STC, defined in ASTM E413-10. The shaded cells in the table and areas in the graph are outside the STC contour range.

In the table:
Values marked "clc" indicate that the measured sound transmission loss of the specimen was calculated according to ASTM E90-09, section A.3.2.7. A correction through the filler wall was applied for calculating the sound transmission loss of the single pane wood window with the Magnetite Framing System. Values marked "min" indicate that the measured sound transmission loss of the specimen was calculated according to ASTM E90-09, section A.3.2.8 and the values give an estimate of the lower limit of airborne sound transmission loss.

4. Differences in Sound Transmission Loss (TL) with Magnetite Framing System on Single Pane Wood Window

Table 4. Sound Transmission Loss (TL) Measurements of Single Panel Wood Window with and without Magnetite Framing System

Frequency (Hz)	TL of Single Pane Wood Window with Magnetite Framing System (dB)	TL of Single Pane Wood Window (dB)	Differences (dB)
125	25	20	5
160	24	21	3
200	28	21	7
250	28	21	7
315	34	22	12
400	39	24	15
500	44	25	19
630	48	27	21
800	53	29	24
1000	58	31	27
1250	60	32	28
1600	60	33	27
2000	62	34	28
2500	60	32	28
3150	52	23	29
4000	56	26	30
STC of Single Pane Wood Window with Magnetite Framing System		**STC of Single Pane Wood Window**	**Difference in STC value**
43		**27**	**16**

5. Double Pane Aluminum Window Mounted in Filler Wall

Description

1457 mm high x 1178 mm wide double pane aluminum window was mounted in the 2440 mm high x 3658 mm wide filler wall. See Section 1 for the description of the filler wall.

Framing

- Support structure for the window was built with double rows of 92 mm (3-5/8") 25 gauge steel studs (steel thickness: 0.46 mm/0.018") with an air gap of 25 mm (1") between the studs.
- Support structure was lined with two layers of 15.9 mm (5/8") type X gypsum board on the side and several layers of 15.9 mm (5/8") type X gypsum board on the top to fit the window. A small gap of less than 5 mm was left opened between the two rows of framing. The gap was filled with backer rods, caulking and aluminum tape.
- A layer of sill gasket was placed at the bottom of the support structure.
- Gaps along the perimeter of the window were filled with backer rods, caulking and aluminum tape.

Table 5. Specimen Properties of Single Pane Wood Window

Element	Actual thickness (mm)	Mass (kg)
Double Glass Pane Aluminum Window	115*	42.4

* Element thickness includes the aluminum sash of the window.

Figure 4. 1457 mm high x 1178 mm wide double pane aluminum window was mounted in the 2440 mm high x 3658 mm wide filler wall.

ASTM E90 Test Results – Airborne Sound Transmission Loss

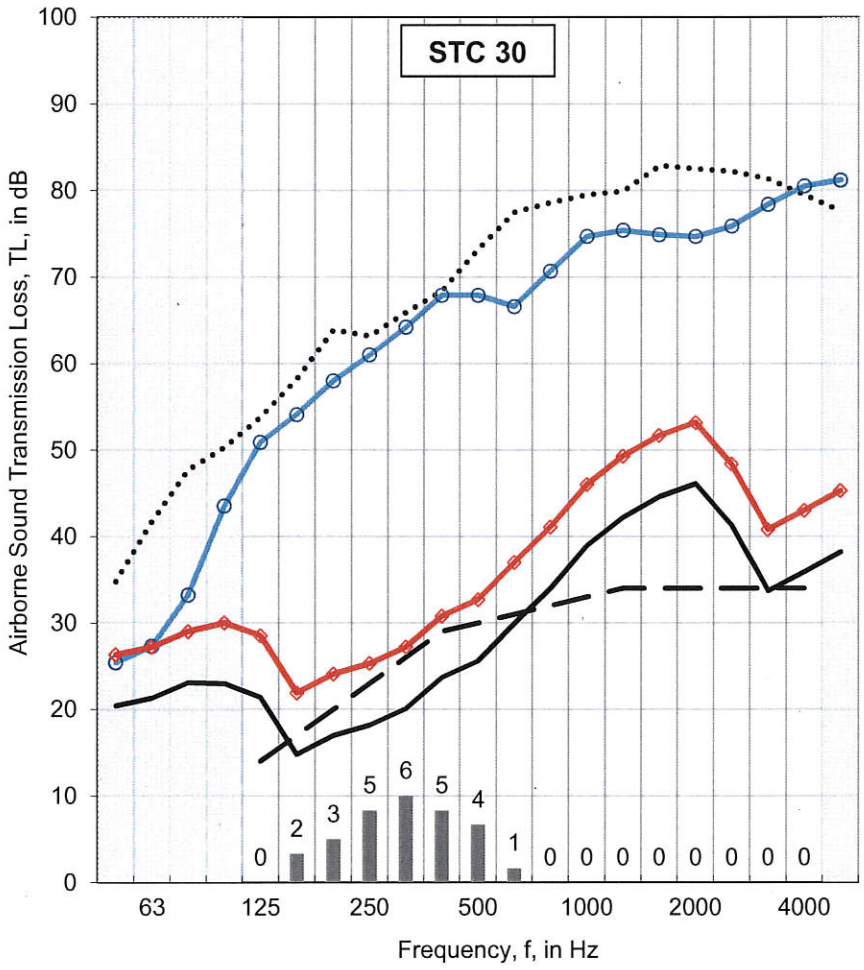
Client: Magnetite Canada **Test ID:** TLA-16-067

Specimen ID: A1-009464-2W **Date of Test:** August 22, 2016

Room	Volume (m^3)	Air Temperature (°C)	Humidity (%)
Large	254.9	21.6 to 21.6	50.5 to 50.9
Small	140.6	21.7 to 21.7	53.4 to 54.3

Area of test specimen:	1.72 m^2
Mass of test specimen:	42.4 kg

f (Hz)	TL (dB)	
50	20	min
63	21	min
80	23	min
100	23	clc
125	21	
160	15	
200	17	
250	18	
315	20	
400	24	
500	26	
630	30	
800	34	
1000	39	
1250	42	
1600	45	
2000	46	
2500	41	
3150	34	
4000	36	
5000	38	
Sound Transmission Class (STC)	**30**	



Sum of Deficiencies (dB)
26
Max. Deficiency (dB)
6 dB at 315 Hz

For a description of the test specimen and mounting conditions see text pages before. The results in this report apply only to the specific sample submitted for measurement. No responsibility is assumed for performance of any other specimen. **Airborne sound transmission loss measurements were conducted in accordance with the requirements of ASTM E90-09, "Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements."**

In the graph:

The blue solid line with circle markers is the measured sound transmission loss of the filler wall. The red solid line with diamond markers is the measured sound transmission loss of the filler wall with the double pane aluminum window. The black solid line is the calculated sound transmission loss for the double pane aluminum window. The dashed line is the STC contour fitted to the calculated values according to ASTM E413-10. The dotted line (may be above the displayed range) is 10 dB below the flanking limit established for this facility. For any frequency band where the measured transmission loss is above the dotted line, the reported value is potentially limited by flanking transmission via laboratory surfaces, and the true value may be higher than that measured. Bars at the bottom of the graph show deficiencies where the measured data are less than the reference contour as described in the fitting procedure for the STC, defined in ASTM E413-10. The shaded cells in the table and areas in the graph are outside the STC contour range.

In the table:

Values marked "clc" indicate that the measured sound transmission loss of the specimen was calculated according to ASTM E90-09, section A.3.2.7. A correction through the filler wall was applied for calculating the sound transmission loss of the double pane aluminum window. Values marked "min" indicate that the measured sound transmission loss of the specimen was calculated according to ASTM E90-09, section A.3.2.8 and the values give an estimate of the lower limit of airborne sound transmission loss.

6. Double Pane Aluminum Window with Magnetite Framing System

Description

1498 mm high x 1196 mm wide Magnetite Framing System was installed next to the 1457 mm high x 1178 mm wide double pane aluminum window with an airspace of 100 mm (4") between the glass pane and the Magnetite acrylic pane. See Section 1 for the description of the filler wall and Section 5 for the description of the double pane aluminum window.

Framing

- 25 gauge power coated steel L bars lined with 5 mm foam tape were attached to the perimeter of the test opening on the large chamber side 100 mm (4") away from the double pane aluminum window.
- 100 mm (4") wide x 19 mm (¾") thick white foam strip lined the perimeter between glass pane and Magnetite acrylic pane.
- Magnetite Framing System attached to the steel L bars with backer rods around the outside perimeter of the Framing System.

Table 6. Specimen Properties of Magnetite Framing System

Element	Actual thickness (mm)	Mass (kg)
6 mm acrylic pane with magnetic strip on one side of the metal frame	15 mm*	13.6

* Element thickness includes the metal frame of the Magnetite Framing System.

Figure 5. 1496 mm high x 1196 mm wide Magnetite Framing System was installed 100 mm away from the 1457 mm high x 1178 mm wide double pane aluminum window.

ASTM E90 Test Results – Airborne Sound Transmission Loss

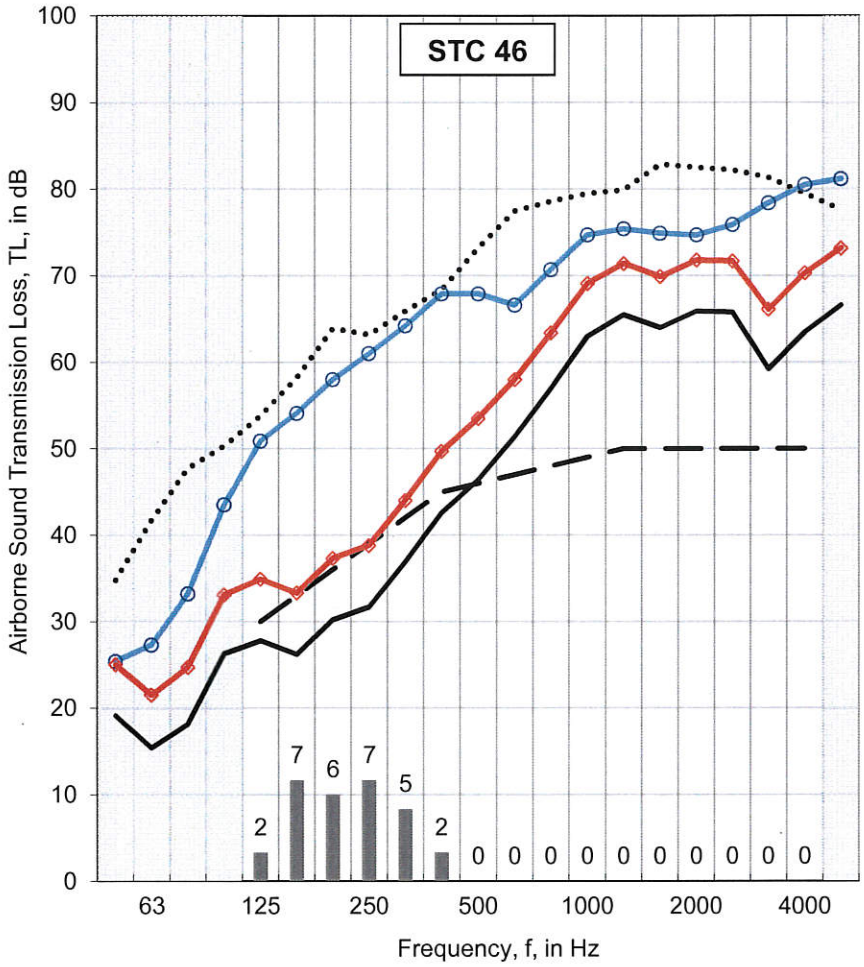
Client: Magnetite Canada **Test ID:** TLA-16-066

Specimen ID: A1-009464-2WM **Date of Test:** August 22, 2016

Room	Volume (m³)	Air Temperature (°C)	Humidity (%)
Large	254.9	21.7 to 21.7	48.1 to 49.9
Small	140.6	21.4 to 21.6	49.9 to 52

Area of test specimen:	1.72 m^2
Mass of test specimen:	13.6 kg

f (Hz)	TL (dB)	
50	19	min
63	15	clc
80	18	clc
100	26	clc
125	28	
160	26	
200	30	
250	32	
315	37	
400	43	
500	46	
630	51	clc
800	57	clc
1000	63	clc
1250	66	min
1600	64	min
2000	66	min
2500	66	min
3150	59	clc
4000	64	clc
5000	67	clc
Sound Transmission Class (STC)	**46**	



Sum of Deficiencies (dB)
29
Max. Deficiency (dB)
7 dB at 160 Hz and 250 Hz

For a description of the test specimen and mounting conditions see text pages before. The results in this report apply only to the specific sample submitted for measurement. No responsibility is assumed for performance of any other specimen. **Airborne sound transmission loss measurements were conducted in accordance with the requirements of ASTM E90-09, "Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements."**

In the graph:

The blue solid line with circle markers is the measured sound transmission loss of the filler wall. The red solid line with diamond markers is the measured sound transmission loss of the filler wall with the double pane aluminum window and the Magnetite Framing System. The black solid line is the calculated sound transmission loss of the double pane aluminum window with the Magnetite Framing System. The dashed line is the STC contour fitted to the calculated values according to ASTM E413-10. The dotted line (may be above the displayed range) is 10 dB below the flanking limit established for this facility. For any frequency band where the measured transmission loss is above the dotted line, the reported value is potentially limited by flanking transmission via laboratory surfaces, and the true value may be higher than that measured. Bars at the bottom of the graph show deficiencies where the measured data are less than the reference contour as described in the fitting procedure for the STC, defined in ASTM E413-10. The shaded cells in the table and areas in the graph are outside the STC contour range.

In the table:

Values marked "clc" indicate that the measured sound transmission loss of the specimen was calculated according to ASTM E90-09, section A.3.2.7. A correction through the filler wall was applied for calculating the sound transmission loss of the double pane aluminum window with the Magnetite Framing System. Values marked "min" indicate that the measured sound transmission loss of the specimen was calculated according to ASTM E90-09, section A.3.2.8 and the values give an estimate of the lower limit of airborne sound transmission loss.

7. Differences in Sound Transmission Loss (TL) with Magnetite Framing System on Double Pane Aluminum Window

Table 7. Sound Transmission Loss (TL) Measurements of Double Pane Aluminum Window with and without Magnetite Framing System

Frequency (Hz)	TL of Double Pane Aluminum Window with Magnetite Framing System (dB)	TL of Double Pane Aluminum Window (dB)	Differences (dB)
125	28	21	7
160	26	15	11
200	30	17	13
250	32	18	14
315	37	20	17
400	43	24	19
500	46	26	20
630	51	30	21
800	57	34	23
1000	63	39	24
1250	66*	42	≥ 24
1600	64*	45	≥ 19
2000	66*	46	≥ 20
2500	66*	41	≥ 25
3150	59	34	25
4000	64	36	28
STC of Double Pane Aluminum Window with Magnetite Framing System		**STC of Double Pane Aluminum Window**	**Difference in STC value**
46		**30**	**16**

* Values indicate that the measured sound transmission loss of the specimen was calculated according to ASTM E90-09, section A.3.2.8 and the values give an estimate of the lower limit of airborne sound transmission loss.

Appendix A: ASTM E90-09 Airborne Sound Transmission Loss Measurement Procedure

Facility and Equipment: The NRC Construction Wall Sound Transmission Facility comprises two reverberation rooms (referred to in this report as the large and small rooms) with a moveable test frame between the two rooms. The large room has an approximate volume of 255 m^3 while the small room has an approximate volume of 140 m^3. In each room, a calibrated Brüel&Kjaer condenser microphone (type 4166 or 4165) with preamplifier is moved under computer control to nine positions, and measurements are made in both rooms using a National Instrument NI-4472 system installed in a computer. Each room has four loudspeakers driven by separate amplifiers and noise sources. To increase randomness of the sound field, there are fixed diffusing panels in each room.

Test Procedure: Airborne sound transmission loss measurements were conducted in accordance with the requirements of ASTM E90-09, "Standard Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions". Airborne sound transmission loss tests were performed in the forward (receiving room is the large room) and reverse (receiving room is the small room) directions. Results presented in this report are the average of the tests in these two directions. In each case, sound transmission loss values were calculated from the average sound pressure levels of both the source and receiving rooms and the average reverberation times of the receiving room. One-third octave band sound pressure levels were measured for 32 seconds at nine microphone positions in each room and then averaged to get the average sound pressure level in each room. Five sound decays were averaged to get the reverberation time at each microphone position in the receiving room; these reverberation times were averaged to get the average reverberation times for each room. Information on the flanking limit of the facility and reference specimen test results are available on request.

Significance of Test Results: ASTM E90-09 requires measurements in one-third octave bands in the frequency range between 100 Hz and 5000 Hz. Within this range, reproducibility has been assessed by inter-laboratory round robin studies. The standard recommends making measurements and reporting results over a larger frequency range, and this report presents such results, which may be useful for expert evaluation of the specimen performance. The precision of results outside the 100 Hz to 5000 Hz range has not been established, and is expected to depend on laboratory-specific factors.

Sound Transmission Class (STC): The Sound Transmission Class (STC) was determined in accordance with ASTM E413-10, "Classification for Rating Sound Insulation." It is a single number rating scheme intended to rate the acoustical performance of a partition element separating offices or dwellings. The higher the value of the STC rating, the better the performance of the building element is expected to be. The rating is intended to correlate with subjective impressions of the sound insulation provided against the sounds of speech, radio, television, music, and similar sources of noise characteristic of offices and dwellings. The STC is of limited use in applications involving noise spectra that differ markedly from those referred to above (for example, heavy machinery, power transformers, aircraft noise, motor vehicle noise). Generally, in such applications it is preferable to consider the source levels and insulation requirements for each frequency band.

In-Situ Performance: The ratings obtained by this standard test method tend to represent an upper limit of what might be measured in a field test, due to structure-borne sound transmission ("flanking") and construction deficiencies in actual buildings.